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The impacts of the continental ice sheets and the external forcing for the last glacial maximum and 65kyr BP on atmospheric dynamics and precipitation in Europe

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During glacial periods the boundary conditions of the atmosphere strongly differ from the ones that are observed today. On the one hand, the external forcing level – especially considering the solar insolation – is lower and, on the other hand, the topography (in particular the ice sheets), the sea surface temperature and the vegetation are changed. As a consequence of these differences, the mean state and the variability of the atmosphere are affected. For the precipitation, studies have shown different impact factors. The lower mean temperature in glacial periods results in a general reduction of the precipitation, but due to synoptic-scale circulation changes also positive precipitation anomalies are found.

Here, we simulate and investigate two glacial periods during the Pleistocene, namely the last glacial maximum (LGM, 21kyr BP) and an earlier period with smaller ice sheets (65kyr BP). For these two periods and also for present day conditions, 30-yr time-slice experiments are performed using the atmosphere-land model version of the Community Earth System Model in a horizontal resolution of 0.9x1.25°. For the LGM, both the sea level change and the ice sheets are prescribed based on the ICE-5G dataset. For the 65kyr BP period, the sea level change accounts only for approximately 2/3 of the LGM change and the distribution of the ice sheets is not known. Thus, several different ice sheet distributions are used that correspond to the observed sea level change.

The goal of this work is to investigate the impacts of different glacial boundary conditions on the precipitation – especially focusing on Europe. To identify the causes of precipitation anomalies, the atmospheric circulation is analysed. In addition, the glacial periods are compared with present day conditions.